Division of Air Quality

7 DE Administrative Code 1140:
DELAWARE LOW EMISSION VEHICLE PROGRAM

Background Document and Technical Support for Public Hearing on the Proposed Amendments to the LEV III and Greenhouse Gas Vehicle Standards

September 2013

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List of Acronyms

A/C	Air conditioning
ARB	California Air Resources Board
AT PZEV	Advanced Technology Partial Zero Emission Vehicle
CAA	Clean Air Act
CAFE	Corporate average fuel economy
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DAQ	Division of Air Quality
EPA	U.S. Environmental Protection Agency
FTP	Federal test procedure
gCO_2/mi	gram CO_2 per mile
GHG	Greenhouse Gas
HFC	Hydrofluorocarbon
ISOR	Initial Statement of Reasons
IVM	Intermediate Volume Manufacturers
LDT_1	Light Duty Truck with a loaded vehicle weight of 0-3750 pounds
LDT_2	Light Duty Truck with a loaded vehicle weight of 3750 to 8500 pounds
LEV	Low Emission Vehicle
LFCE	Low Fuel Cycle Emissions
LVM	Large Volume Manufacturers
MDPV	medium-duty passenger vehicles
MY	Model Year
N_2O	Nitrous oxide
NHTSA	National Highway Traffic Safety Administration
NMHC	Non methane hydrocarbons
NMOG	Non Methane Organic Gas
NOx	Nitrogen Oxides
OTC	Ozone Transport Commission
PCs	Passenger Cars
PFI	Port fuel injection
PM	Particular matter
PZEV	Partial Zero Emission Vehicle
ROG	Reactive organic gases
SFTP	Supplemental federal test procedure
SULEV	Super Ultra-Low Emission Vehicles
SUV	Sports Utility Vehicles
ULEV	Ultra-Low-Emission Vehicle
ZEV	Zero Emission Vehicle

Background Document and Technical Support for Public Hearing:

To Consider Amendments to Adopt the California LEV III and Greenhouse Gas Vehicle Standards Passenger Cars, Light-Duty Trucks, and Medium-Duty Passenger Vehicles

7 DE Admin C 1140: Delaware Low Emission Vehicle Program

September 2013

The proposed amendments to 7 DE Admin C 1140, the Delaware Low Emission Vehicle (LEV) Program regulation, incorporate modifications made by California to its LEV program. The amendments proposed by California, also known as Advanced Clean Cars Program, include the adoption of LEV III and Greenhouse Gas (GHG) standards for passenger cars, light-duty trucks, and medium-duty passenger vehicles.

I. EXECUTIVE SUMMARY

Delaware Division of Air Quality (DAQ) is proposing to adopt the California's Low Emission Vehicle (LEV) III and Greenhouse Gas (GHG) revisions (also known as the Advanced Clean Cars Program) under the Delaware LEV Program regulation, 7 DE Admin C 1140. The Advanced Clean Cars Program combines the control of smog-causing pollutants and GHG emissions into a single coordinated package of requirements for model years (MYs) 2015 to 2025 for LEV III standards and MYs 2017-2025 for GHG standards.

Delaware is committed to protecting public health and the environment through programs and policies that address air pollution and climate change. Smog, particle pollution, and toxic pollutants pose serious health concerns and increase the incidence of cardio-pulmonary diseases, asthma, and cancer, especially for sensitive groups of people including children, older adults, and people with heart or lung diseases.

Although significant progress has been made in addressing air pollution in Delaware, continued reductions of criteria pollutant emissions are needed to ensure and maintain federal ambient air quality standards. Significant reductions in GHG emissions are needed to address the growing threat of climate change in Delaware. In addition to reducing air pollution, the proposed amendments are designed to preserve consumer choice while ensuring the development of a full range of environmentally superior cars from compact cars to sports utility vehicles (SUVs) and pickup trucks. These vehicles will continue to deliver the performance, utility, and safety consumers have come to expect along with savings from reduced fuel costs, given higher mileage requirements and enhanced warranties.

Reducing emissions of criteria and other toxic air pollutants (non-methane hydrocarbons, nitrogen oxides, particulate matter, carbon monoxide, benzene, 1-3 butadiene, and formaldehyde) to improve air quality is one of the key objectives of the Advanced Clean Cars Program. By MY 2025, new vehicles will emit 75% less smog-forming pollution (mainly non-methane hydrocarbons and nitrogen oxides)

than the average new car sold today. The LEV III proposal for new criteria pollutant emission standards continues the tradition of requiring advanced state-of-the-art emission control technology standards for future MYs in the interest of protecting public health. There are several major proposed modifications to the LEV III regulations, including a fleet average super ultra-low-emission vehicle (SULEV) level for new vehicles by MY 2022, increased stringency and restructuring of the Non Methane Organic Gas (NMOG) and oxides of nitrogen (NO_x) standards, increased stringency for particular matter (PM) standards, increased durability requirements for emission control systems, expanded coverage of more restrictive evaporative control requirements, new requirements for supplemental test procedure emission testing, and new federal fuel economy and environmental labeling requirements.

There are many benefits to the Advanced Clean Cars Program, including consumer savings and reductions in smog forming emissions and greenhouse gases. Reducing GHG emissions from vehicles is the second key objective of the Advanced Clean Cars Program. The Advanced Clean Cars Program is expected to deliver a 75% reduction in smog-forming emissions from new vehicles by 2025 (compared to 2014 levels) and GHG emissions will be reduced by 2.5 million metric tons per year by 2025.

Although the proposed Advanced Clean Cars Program is expected to increase prices for new vehicles, these more fuel efficient vehicles are also expected to reduce fuel costs for the consumers. While much of the price increase for new vehicles will be passed on to consumers, the overall savings from these vehicles complying with the regulation will positively affect consumers and most businesses. The combined impact of the proposed amendments contained in the Advanced Clean Cars Program is an expected reduction in fuel-consumption for new vehicles ranging from approximately 4% to over 25% for MY 2017 to 2025 vehicles, respectively. The overall average increase in price of the vehicles compared to the overall reduction in fuel costs can be expressed as - for every dollar spent, consumers would save $3.[1]

II. INTRODUCTION

Since the development and adoption of the California LEV program in the early 1990s, manufacturers have made significant technological advances in reducing emissions from passenger cars (PCs), light-duty trucks (LDTs), and medium-duty passenger vehicles (MDPVs). However, growing populations and the increasing use of motor vehicles will continue to exert an upward pressure on statewide emissions for smog, particle pollution, and other toxic pollutants. Exposure to these pollutants poses serious health concerns which can lead to increased incidence of cardio-pulmonary diseases, asthma, and cancer. Some groups of people are especially sensitive to air pollutants, including children, older adults, and people with heart or lung diseases. In addition, there is a growing awareness that climate change will pose a significant threat to the Delaware economy, public health, water resources, infrastructure, coastal resources, and energy demand.

[1] ARB Staff Report: Initial Statement of Reasons - LEV III Amendments to the California Greenhouse Gas and Criteria Pollutant Exhaust and Evaporative Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles, December 7, 2011.

a. Overview of the Proposed Regulation

Delaware is addressing the contribution of motor vehicles to air pollution, including climate change, and is proposing to adopt California's 2012 amendments into its LEV program, known as the Advanced Clean Cars Program. The Advanced Clean Cars Program includes proposed amendments to the LEV III and GHG standards. For criteria pollutants, LEV III reduces vehicle emissions to SULEV levels by 2025, which represents vehicle emission reductions of 99% from uncontrolled vehicle emissions.

The proposed GHG standards that continue the so-called "Pavley" standards developed in 2003-2004 for MY 2009-2016 vehicles require additional reductions in GHG emissions from vehicles beyond MY 2016. However, the proposed GHG standards differ from the fleet average GHG requirement under Pavley by establishing a set of "footprint" curves for each MY.[2] These footprint curves establish target GHG emissions for each vehicle model depending on its footprint. Thus, manufacturers may produce models that emit above the footprint curve as long as their emissions are offset by models that emit below the footprint curve.

b. Organization of the Report

Section III provides a discussion of the proposed changes to LEV III criteria pollutant standards, including changes to the Evaporative Emission Regulation and Vehicle Labeling Requirements. Section IV discusses the proposed changes to the light-duty GHG emissions standards. Section V provides a description of the air quality impacts associated with the proposed amended in the Advanced Clean Cars Program. Section VI describes the economic impacts of the proposed regulations on consumers.

III. LOW EMISSION VEHICLE EXHAUST EMISSION STANDARDS

a. Background

In 1967, the federal Clean Air Act (CAA) established the framework for controlling mobile source emissions in the United States. Although states were preempted by Section 209 of the CAA from adopting state emissions standards, California was granted a special exemption to the federal preemption due to the state's unique air quality problems. This exemption gave California the authority to set its own vehicle emission standards as long as such standards are at least as protective as the federal standards.[3] A subsequent amendment to the CAA added Section 177 that allows other states to adopt the California standards.[4]

In 1999, the Delaware Division of Air Quality (DAQ) adopted a low emission program by promulgating 7 DE Admin C. 1140, the LEV Program. The program was implemented to meet statutory obligations and to reduce air pollution through the reduction of VOCs and NOx generated

[2] A vehicle's footprint is the area defined by the wheelbase times the average track width of the vehicle.
[3] U.S.EPA, Title II – Emission Standards for Moving Sources, Part A – Section 209, 42 U.S.C. §7543
[4] U.S.EPA, Title I – Air Pollution Prevention and Control, Part D – Section 177, 42 U.S.C. §7507

from motor vehicle emissions. DAQ is required to adopt California's vehicle emissions standards as long as those standards achieve, *in the aggregate*, greater emissions reductions than the federal standards.

On November 5, 1998, the ARB approved a comprehensive package of stringent motor vehicle emission standards that apply to all light- and medium-duty vehicles beginning in MY 2004. These standards are collectively known as "LEV II." In 2010, DAQ adopted the LEV II standards for all light- and medium-duty vehicles beginning with model year (MY) 2004. These amendments set more stringent fleet average non-methane organic gas (NMOG) requirements and established a new more stringent SULEV standard. In addition, a partial zero-emission vehicle (PZEV) category was established for vehicles meeting the SULEV emission standard that also included extended 150,000 mile durability, zero fuel evaporative emissions, and extended emission warranty requirements. The amendments also expanded the LDT category to include trucks and sport utility vehicles (SUVs) to meet the same emission standards as PCs, and extended full useful life from 100,000 miles to 120,000 miles. The LEV II amendments established more stringent emission standards for medium-duty vehicles (MDVs) between 8,501 – 14,000 gross- weight rating.

The LEV III proposal for new criteria pollutant emission standards continues the tradition of requiring advanced state-of-the-art emission control technology for future MYs to protect public health. The proposed standards require fleet average SULEV-level emissions performance from new vehicles by MY 2022 for criteria and other pollutants, including non-methane hydrocarbons (NMHCs), nitrogen oxides (NO_x), particulate matter (PM), carbon monoxide (CO) and air toxics. Among the areas of proposed modifications are increased stringency and restructuring of the NMOG and NO_x standards, increased stringency for PM standards and durability requirements for emission control systems, expanded coverage of more restrictive evaporative control requirements, new requirements for supplemental test procedure emission testing, and new federal fuel economy and environmental labeling requirements.[5]

The Delaware proposed standards directly cite and/or incorporate by reference the applicable sections within Title 13 of the California Code of Regulations and include:

- Exhaust Emission Standards and Test Procedures - 2015 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles.
- Greenhouse Gas Exhaust Emission Standards and Test Procedures - 2017 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles.

Section 177 also requires that states adopting the California motor vehicle emission standards provide the manufacturers with at least two model years lead time before the standards may be enforced. The Department is proposing to adopt the California LEV III and GHG standards prior to the beginning of MY 2015, which begins on January 2, 2014. The DAQ realizes that having the standards in place to have met the lead time requirement is impossible. Nevertheless, DAQ expects that the manufacturers will elect to comply with the MY 2015 LEV III standards in Delaware, in large measure due to their ability to generate early credits which can be used to comply in subsequent model years when the

[5] ARB, Appendix A – LEV III Proposed Regulation Order, December 7, 2011.

program's requirements become more stringent. The Department is not proposing any standards or requirements which would create an undue burden on the manufacturers by either preventing the sale of a vehicle certified to California standards, or by requiring the creation of a "third vehicle."

b. Need for and Summary of Regulatory Amendments

The ARB proposed to adopt the LEV III standards to achieve further emission reductions from light- and medium-duty fleet and finalized these standards in 2012. Therefore, DAQ is proposing to adopt these revisions made by ARB under the LEV Program regulations, 7 DE Admin C 1140, which would apply to MY 2015 to 2025 PCs, LDTs, and MDPVs.

The LEV III standards will drive the development of the cleanest cars that use diesel, gasoline, or gasoline-electric hybrid internal combustion engines. The technology for controlling vehicle emissions is well understood and manufacturers have a wide range of available emission control technologies to meet the LEV III requirements. The LEV III regulations consist of three distinct parts: A) exhaust emission criteria requirements, including the supplemental federal test procedure (SFTP): B) evaporative emission requirements and the technical feasibility and costs to achieve the requirements: C) California's environmental performance labeling requirements to ensure that the new federal Fuel Economy and Environmental Label meets California's vehicle labeling requirements.

1. Exhaust Criteria Requirements

California's Low-Emission Vehicle Exhaust Emission Standards
The LEV III standards represent a significant strengthening of the LEV program. Major elements of the proposed amendments, as described in more detail below, would:

1. Reduce fleet average emissions of new PCs, LDTs and MDPVs to SULEV levels by 2025;
2. Replace separate NMOG and NO_x standards with combined NMOG plus NO_x standards;
3. Increase full useful life durability requirements from 120,000 miles to 150,000 miles;
4. Provide a backstop to assure continued production of SULEV after the PZEVs are moved as a compliance strategy to the LEV III program in 2018;
5. Establish more stringent PM standards for LDTs and MDVPs;
6. Establish more stringent SFTP standards for PC and LDTs and require MDVPs to meet SFTP standards; and
7. Allow pooled fleet average NMOG plus NO_x emissions from California and Section 177 States that adopt the LEV III program.

NMOG plus NOx SULEV Fleet Average Emission Requirement
Although achieving SULEV emission levels across the light-duty and medium-duty fleet is challenging, the proposed revisions to LEV III provide the flexibility for manufacturers to meet the more stringent standards through: 1) combined NMOG plus NO_x standards, which will enable manufacturers to more cost-effectively tailor their emission control systems; 2) an array of emission standards to which manufacturers may certify their vehicles, as long as their fleet average emissions meet declining fleet average requirement; and 3) an extended phase-in period for manufacturers to incorporate improved emission control systems across their vehicle lines.

Table 1 lists the proposed fleet average NMOG plus NO_x requirements for PCs, LDTs, and MDPVs for MYs 2015-2025. The NMOG fleet average requirement is replaced by NMOG plus NO_x and is tightened down to SULEV emission levels by 2025, or approximately a 75% reduction in emissions from current standards.

Table 1 Fleet average NMOG plus NO_x requirements for PC, LDTs, and MDPVs (150,000 mile durability basis)

MY	Fleet Average NMOG plus NO_x (grams per miles)	
	All PCs and LDT1s	LDT2s and MDPVs
2015	0.100	0.119
2016	0.093	0.110
2017	0.086	0.101
2018	0.079	0.092
2019	0.072	0.083
2020	0.065	0.074
2021	0.058	0.065
2022	0.051	0.056
2023	0.044	0.047
2024	0.037	0.038
2025	0.030	0.030

LDT1: Vehicles with a gross vehicle weight rating (GVWR) between 0 and 3750 pounds.
LDT2: Vehicles with a GVWR between 3,751 and 8,500 pounds.

The proposed amendments to LEV III provide for three additional light-duty vehicle emission standards for ultra-low emission vehicles and SULEV (ULEV70, ULEV50, and SULEV20[6]) to which manufacturers may certify their vehicles after meeting the fleet average emission requirement.

The phase-in period will allow manufacturers to phase-in additional components across their fleet in a more cost-effective manner. Table 2 shows the phase-in requirements of the fleet that will be required to be certified to the LEV III Federal Test Procedures (FTP) and SFTP standards.

Table 2 Phase-in Requirements for PCs, LDTs, and MDPVs

LEV III FTP and SFTP Phase-in					
Year	**2015**	**2016**	**2017**	**2018**	**2019**
PC/LDT1	10%	20%	40%	70%	100%
LDT2/MDPV	10%	20%	40%	70%	100%

Extension of Full Useful Life Standards to 150,000 Miles

Currently, the intermediate useful life standard is 50,000 miles and a full life standard is 120,000 miles. The proposed amendments eliminate the intermediate useful life standards, retain only the full useful life standards, and align compliance requirements with the current SULEV requirement, which are currently 120,000. This is being implemented in conjunction with a requirement that extends the full

[6] The numerical part of the standard category, such as 20 in SULEV20, refers to the emission standard, in thousandths of a gram per mile or 0.020g NMOG+NO_x/mi.

useful life standards from 120,000 to 150,000 miles. Extending the full useful life would ultimately lower in-use emissions as vehicles age.

Backstop for PZEV Vehicle Production
Starting in MY 2018, PZEVs and advanced technology partial zero-emission vehicles (AT PZEVs) will transition to the LEV program. Manufacturers will be required to continue to certify a percentage of their new vehicle fleet to meet the SULEV exhaust emission standards. This will ensure the continued production of these vehicles as the manufacturers are required to meet the declining NMOG plus NO_x fleet average requirement.

PC, LDT, and MDPV Particulate Matter Emission Standards
The LEV II standard for particulate matter (PM) for light-duty vehicles is 0.010 grams per mile (g/mi). The LEV III PM standard is reduced to 0.003 g/mi for PCs and LDTs. Moreover, there are phase-in requirements. The phase-in requirements represent the minimum percentage of a manufacturer's vehicle sales that must comply with the 0.003 g/mi PM standard and the remainder of the sales may comply with the 0.010 g/mi PM standard. Table 3 lists the phase-in requirements.

Table 3 Phase-in Requirements for Particulate Matter

Year	2017	2018	2019	2020	2021
PC/LDT1	10%	20%	40%	70%	100%
LDT2/MDPV	10%	20%	40%	70%	100%

An interim in-use compliance standard of 0.006 g/mi is proposed during the phase-in period. Vehicles certifying to the 0.003 g/mi PM standard during MYs 2017-2021 would be held to 0.006 g/mi.

SFTP Exhaust Emission Standards
The SFTP program was developed to quantify and control motor vehicle emissions not accounted for under the FTP. SFTP captures the "off-cycle" emissions resulting from aggressive driving and air conditioning use. Beginning with MY 2015 and phased in through MY 2025, changes to the SFTP program will include:

1) **Increasing durability requirements to full useful life**
   A 150,000 mile durability requirement for SFTP emission standards is proposed to replace the current 4,000 mile durability requirement. ARB developed the 150,000 mile SFTP emission standards (based on the findings that as vehicles age, increases in SFTP emissions are generally equivalent to increases in FTP emissions). This change would ensure that the control of off-cycle emissions is extended throughout the full useful life of on-road vehicles.

2) **SFTP requirement**
   The SFTP requirements apply to MY 2015 and subsequent MY PCs, LDTs, and MDPVs, and 2016 and subsequent MY MDVs. MDVs and alternative fueled vehicles were not previously subject to SFTP requirements because test data were not available to show that they could comply, but current driving patterns and emissions data show that these vehicles should be included in the SFTP requirements.

3) **Develop more stringent emission standards**
Manufacturers have two pathways to comply with SFTP NMOG+NO_x and CO emission standards for their PCs, LDTs, and MDPVs: Option 1 is a stand-alone emission standard; Option 2 is a composite emission standard approach with a fleet-average provision for NMOG+NO_x. The second option can accommodate diesel fueled vehicles through less stringent emission standards and a fleet averaging provision. If a manufacturer has a higher SFTP emissions from diesel vehicles, it could make cleaner gasoline fueled vehicles to partially offset the diesel emissions. A test group certified to the 150,000 mile durability requirements for LEV III FTP would also be required to certify to 150,000 mile SFTP emission standards under either approach. These options would provide flexibility without compromising the required emission reductions.

The SFTP is also applicable to MDVs starting with MY 2016. For NMOG+NO_x and CO, MDVs certifying to SFTP standards would be required to comply with the composite emission standards.

4) **SFTP PM Emission Standards**
The new SFTP Exhaust Emission Standards are intended to prevent excessive oil consumption and fuel enrichment during aggressive driving. Typically, gasoline direct injection (GDI)[7] engines have higher PM emissions than port fuel injection (PFI)[8] engines. Since industry has shifted from PFI engines to GDI engines, the PM exhaust levels from gasoline fueled vehicles have become a growing concern. All vehicles certified to 150,000 mile FTP PM emission standards are required to comply with the SFTP PM emission standards. Since the PM standards are based on limited test data, they will be reexamined as additional data become available.

Pooling Fleet Average NMOG plus NO_x Emissions from California and Section 177 States
Starting in MY 2015, manufacturers have the option to comply with the fleet average NMOG plus NO_x requirement by using the pooled fleet average NMOG plus NO_x emissions of new light- and medium-duty vehicles produced and delivered for sale in California and all Section 177 States. "Pooling" is the total number of PCs, LDTs, and MDPVs that are certified to the California exhaust emission standards and are produced and delivered for sale in California, the District of Columbia, and all Section 177 states for that MY. Manufacturers that choose this option would be required to report the number of vehicles produced and delivered for sale and the emission standards to which they are certified for each state that adopts California emission requirements. This flexibility will help manufacturers to meet the fleet average in those states with limited new vehicle sales.

NMOG credits may be carried forward for three years, but are discounted after the first year and sunset in the fourth year. Debits must be offset in the following MY. Credits earned prior to MY 2015 would be discounted under the LEV II protocol and expire four years after they accrued. LEV II NMOG

[7] Advanced internal combustion technology where engines inject fuel directly into the combustion chamber. This provides a cooling effect on the air/fuel mixture, allowing for higher compression ratios that improve engine efficiency and lower CO_2 emissions, ARB ISOR LEV III Amendments, December 7, 2011.
[8] Port fuel injection where fuel is injected and mixed with air in the intake manifold prior to entering the combustion chamber, ARB ISOR LEV III Amendments, December 7, 2011.

credits that are carried forward to MY 2015 to NMOG plus NO_x credits are converted by multiplying the credits by 3.0. This factor is derived from the projected NMOG plus NO_x fleet average in MY 2014 to be approximately three times the NMOG plus NO_x fleet average. Any NMOG debits carried over to MY 2015 would be converted to NMOG plus NO_x debits by multiplying the debits by a factor of 3.0. These debits must be offset by any NMOG plus NO_x credits earned in MY 2015-2018.

Small Volume Manufacturer Requirements

Under LEV II, independent vehicle manufacturers with a three-year sales volume average of 4,500 units per year or less of new PCs, LDTs, MDVs and heavy-duty vehicles and engines in California, are defined as Small Volume Manufacturers. Compliance with the fleet average NMOG requirement for small volume manufacturers was deferred until MY 2007 (the end of the phase-in period). Starting in MY 2007, Small Volume Manufacturers are required to meet a fleet average requirement approximately 53% less stringent than the fleet average requirement for larger volume manufacturers.

Under LEV III, a Small Volume Manufacturer is defined as a manufacturer with a three-year average sales volume of less than 5,000 vehicles and engines nationwide. For qualifying Small Volume Manufacturers, compliance with the LEV III requirements will be deferred until MY 2022.[9] Prior to MY 2022, Small Volume Manufacturers may petition ARB for relaxed emission standards.

2. California's Evaporative Emission Regulations

Evaporative emissions are hydrocarbon vapors from motor vehicles and are classified into three types: running loss (occur during vehicle operation from various sources within the fuel system and from fuel vapor overflow of on-board carbon canisters); hot soak (occur immediately after the termination of engine operation); and diurnal (caused by daily cycling of ambient temperatures when a vehicle is parked).

The evaporative emission standards would begin in MY 2015 and be phased in through MY 2022. From MY 2015 to 2017, the minimum percent requirement would be the average percentage of vehicles generating PZEV credits in its fleet for the previous three MYs. The standards would increase to 60% in 2018, 80% in 2020, and 100% in 2022. In addition to the phase-in requirements, additional compliance flexibility is provided to manufacturers by pooling of evaporative emissions. Manufacturers are allowed to pool the fleet average of the highest Diurnal plus Hot Soak emission of new light- and medium-duty vehicles produced and delivered for sale in California and all states that adopt California's evaporative emission requirements. Manufacturer that choose this option are required to report the number of vehicles produced and delivered for sale and the emission standards, and family emission limits to which they are certified for each state that adopts California emission requirements.

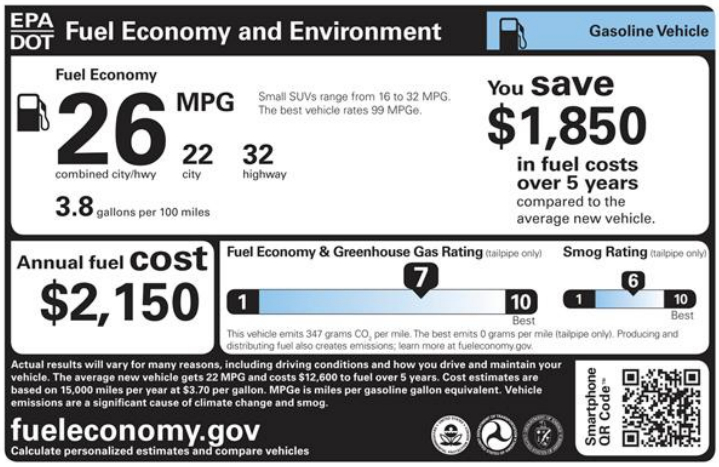
3. Vehicle Labeling Requirements

The California Environmental Performance label is required on all new vehicles manufactured after January 1, 2009. In the spring of 2010, ARB began working with the United States Environmental Protection Agency (U.S. EPA) and the United States National Highway Traffic Safety Administration

[9] ARB: Enclosure A – Proposed 15-Day Modified Text of the "LEV III" Amendments, February 22, 2012.

(NHTSA) on revisions to the Fuel Economy Label. In June 2011, USEPA and NHTSA published 40 CFR Parts 85, 86 and 600, which included requirements for the new Fuel Economy and Environmental label. The new federal label is required on all new cars starting with MY 2013 and can be affixed to vehicles earlier on a voluntary basis. The new federal Fuel Economy Label and Environmental Label includes a GHG and Fuel Economy Rating from 1 to 10 with 10 being the best and a Smog Rating from 1 to 10 with 10 being the cleanest. An example of the new label is shown as Figure 1 below.

Figure 1 Fuel Economy and Environmental label



Under the Advanced Clean Car Program, ARB finalized language in 2012 to the "California Smog Index Label Specifications for 2009 and Subsequent MY Passenger Cars, Light-Duty Trucks, and Medium-Duty Passenger Vehicles," (incorporated by reference at Title 13, California Code of Regulations, Section 1965) that would deem manufacturers in compliance with the federal Economy and Environmental Label published in 40 CFR Parts 85, 86 and 600, as promulgated on July 6, 2011, as compliant with the California Environmental Performance Label requirements. Only those vehicles that qualify for Corporate Average Fuel Economy (CAFE) credits are permitted to affix the federal Fuel Economy and Environmental Label. Because of the successful collaboration between California, U.S. EPA, and NHTSA, California requirements are now addressed by the federal label including the following:

1) Adding the following statement to the label: "Vehicle emissions are a significant cause of climate change and smog."
2) Having a clear statement about upstream emissions and having a place to find this information on a regional basis or at fueleconomy.gov.
3) Including all cars in the rating system rather than segregating by size or class.

IV. LIGHT-DUTY GREENHOUSE GAS EMISSION STANDARDS

a. Background

Climate Change

Scientists have reported that the northern hemisphere has warmed at a rate faster during the past century than at any other time over the last millennium due to the buildup of GHGs, primarily CO_2,

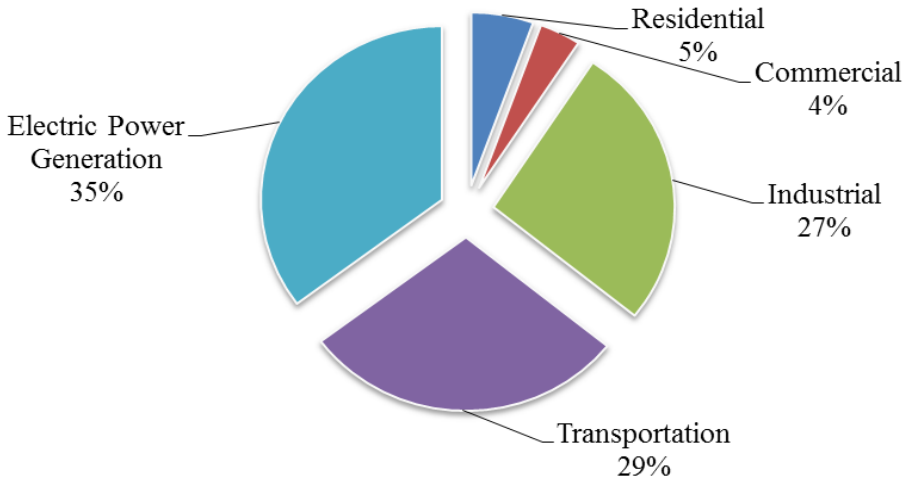
CH_4, N_2O, and HFCs produced from the burning of fossil fuels and clearing of forests. [10] Although GHGs help regulate the Earth's temperature, the atmospheric increase in these gases has intensified the greenhouse effect, leading to climate change. Climate change threatens Delaware's economy, public health, water resources, infrastructure, and coastal resources and can increase energy demand.

Delaware is particularly vulnerable along its coastline. Since a large percentage of the state's population, development, and infrastructure is located along the coast, the impact from climate change could be significant, putting the Delaware economy, health, natural resources, and way of life at risk.

With increasing temperatures, there is an increasing demand on Delaware's energy supply, most of which would occur during the summer months. The increased energy demand for cooling would trigger the electric grid to fire up the region's most expensive energy generation plants, the fossil-fuel powered peaking plants, thereby increasing GHG emissions.

Taken as a whole, these impacts can have significant economic consequences on Delaware. Delaware's transportation sector, as shown in Figure 2, is one of the largest contributors of GHGs in the State, producing 29% of all such emissions. Since the transportation sector is a leading contributor to GHG emissions, Delaware is committed to reduce GHG emissions from the transportation sector by adopting California's GHG regulations for light-duty motor vehicles.

Figure 2 2008 Greenhouse Gas Inventory



Light-Duty GHG Regulation Summary

In 2002, California Assembly Bill 1493 (known as the "Pavley" bill) was signed into law and required ARB to adopt regulations for significant reductions in GHG emissions from new PCs and LDTs beginning with MY 2009 vehicles. In 2004, ARB adopted regulations requiring manufacturers to meet increasingly stringent GHG emissions standards phased in from MY 2009-2016. The standards were

[10] IPCC. (2007). *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf

projected to reduce GHG emissions from the new vehicle fleet in California by 30% within this timeframe.[11] The two revisions made by the ARB to the GHG emission standards for motor vehicles are below:

- The first revision applied to MY (MY) 2009-2011 vehicles. The ARB amendments for MY 2009-2011 vehicles allowed manufacturers to comply with the fleet average GHG emission standards by "pooling" California and Section 177 state vehicle sales as an alternative to complying with the standards on a state-by-state basis. "Pooling" is based on the total number of PCs, LDTs, and MDPVs that are produced and delivered for sale in California and Section 177 states. The amendments also allowed manufacturers to use emissions data from the federal corporate average fuel economy (CAFE) program to demonstrate compliance with California's regulations.

- The second revision applied to MY 2012-2016 vehicles. The ARB amendments for MY 2012-2116 vehicles reflected a May 2009 agreement between the Obama Administration and the State of California with the manufacturers to establish harmonized U.S. EPA and ARB motor vehicle GHG emission standards for MY 2012-2016 vehicles. These standards would also be harmonized with the CAFE standards established by the National Highway Traffic Safety Administration (NHTSA). California agreed to amend its regulations and to adopt the key elements of the national program that allowed manufacturers to demonstrate compliance with California's GHG standards by demonstrating compliance with the U.S. EPA GHG standards.

U.S. EPA's GHG emission standards or the "National Program" provided equivalent or better overall GHG reductions nationwide than if the California GHG standards were implemented in California and the Section 177 States. Under the National Program, manufacturers are required to meet the fleet average GHG emissions level of 250 grams/mile of CO_2 for MY 2016 vehicles. The 250 grams/mile of CO_2-equivalent emissions limit corresponds to 35.5 miles/gallon fuel economy. The revisions were incorporated into the Delaware LEV Program regulations, 7 DE Admin C 1140, and apply to PCs, LDTs, and MDPVs.

Summary of the Proposed 2017-2025 GHG Standards

Despite significant progress in reducing GHG emissions from PCs, LDTs, and MDPVs, climate change continues to pose a serious threat to the economic well-being, public health, natural resources, and environment of Delaware. To address this challenge, vehicle GHG emissions must be significantly reduced. For MY 2017 to 2025 vehicles, the proposed GHG standards will result in CO_2 emission reductions of approximately 4.5% per year for the combined light duty fleet (PCs, LDTs, and MDPVs). The proposed GHG program for MY 2017-2025 vehicles can be summarized as follows:

- The proposed GHG emission standards would reduce CO_2 emissions associated with PCs, LDTs and MDPVs from approximately 251 g-CO_2/mile in MY 2016 to approximately 166 g-CO_2/mile by MY 2025, or approximately 34%.
- The proposed GHG emission standards are consistent with the U.S. EPA approach and adopt separate standards for CO_2, CH_4, and N_2O.

[11] ARB Staff Report: Initial Statement of Reasons for GHG Rulemaking, January 7, 2010.

- The CO_2 standard is determined by the manufacturer's sales-weighted CO_2 target levels for its mix of vehicles based on the vehicles' footprint-indexed CO_2 target levels.
- The CO_2 standard will vary across manufacturers depending on the specific mix of their vehicle models.
- The air conditioning system requirements will be aligned with the federal requirements.
- The proposed standards allow manufacturers to take credit toward meeting the CO_2 standards by reducing GHG emission through air conditioning improvements, by deploying alternative fuel, pre-approved off-cycle CO_2-emission reducing technologies that are currently available but are not acknowledged in standard test-cycle CO_2 measurement (i.e., active grill shutters that improve aerodynamics at high vehicle speeds, solar panels that significantly offset accessory electric loads and/or charge hybrid and electric-drive batteries, and solar control glazing that reduces the load from air conditioning), and by deploying emission-reduction technologies on the largest of pickup trucks.
- Manufacturers can demonstrate compliance with the proposed GHG standards by either providing the number of vehicles that are produced and delivered for sale in Delaware or by pooling the number of vehicles produced and delivered for sale in California, the District of Columbia, and all Section 177 states for that MY.
- A manufacturer that achieves fleet average GHG values lower than the fleet average GHG requirements for the corresponding MY will receive credits in units of g/mi GHG. These credits may be bought, sold, or traded among manufacturers.
- A manufacturer with higher fleet average GHG values than the fleet average GHG requirement for the corresponding MY will accrue debits in units of g/mi GHG. When debits are incurred, they must be equalized within five years by using accumulated credits and/or using credits purchased from other manufacturers.

b. Need for and Summary of Regulatory Amendments

DAQ has revised its LEV regulations to remain consistent with ARB regulations. Adoption of California's Light-Duty Greenhouse Gas Emission Standards MY 2017-2025 vehicles is required to maintain consistency of the Delaware LEV regulations with the ARB GHG Emissions standards. ARB is proposing to harmonize the GHG standards based on the U.S. EPA's approach and to adopt separate standards for CO_2, CH_4, and N_2O.

GHG Emission Target Levels for MY 2017-2025
In general, the proposed MY 2017-2025 GHG emissions standards for PCs, LDTs, and MDPVs are comprised of three emission standards; a CO_2 standard, a CH_4 standard, and a N_2O standard.

The CO_2 standards are derived from a set of target levels for each vehicle model depending on the vehicle's footprint (vehicle wheelbase times the average track width) of the vehicle model. Manufacturers are required to meet the stringent fleet average CO_2 standards based on the vehicles footprint-indexed, CO_2 target levels. There are two target level footprints – one for PCs and one combined for LDTs and MDPVs.

Table 4 provides the gram CO_2 per mile (gCO_2/mi) target value for the specific MY for PCs with a footprint of less than or equal to 41 square feet (ft^2) or greater than 56 ft^2.

Table 4 CO_2 Target Value (gCO_2/mi) for PCs

MY	Footprint ≤ 41 ft^2	Footprint > 56 ft^2
2017	195	263
2018	185	250
2019	175	238
2020	166	226
2021	157	215
2022	150	205
2023	143	196
2025	137	188
2025 and subsequent	131	179

For passenger cars with a footprint greater than 41 square feet and less than or equal to 56 square feet, the following equation will determine the gCO_2/mi target value (value rounded to the nearest 0.1 gCO_2/mi):

$$\text{Target } gCO_2/\text{mile} = [a \times f] + b$$

Where f is the vehicle footprint and coefficients a and b are selected from Table 5 for the applicable MY.

For example, the target gCO_2/mile for a MY 2017 vehicle with a footprint of 50 ft^2 would be calculated as follows:

$$\text{Target } gCO_2/\text{mile} = [4.53 \times 50ft^2] + 8.9$$
$$\text{Target } gCO_2/\text{mile} = 235.4$$

Table 5 CO_2 Target Value (gCO_2/mi) for PCs with Footprint > 41 ft^2 but ≤ 56 ft^2

MY	a	b
2017	4.53	8.9
2018	4.35	6.5
2019	4.17	4.2
2020	4.01	1.9
2021	3.84	-0.4
2022	3.69	-1.1
2023	3.54	-1.8
2025	3.4	-2.5
2025 and subsequent	3.26	-3.2

Table 6 provides the gCO_2/mi target value for the specific MY for light-duty trucks and medium-duty passenger vehicles with a footprint of less than or equal to 41 ft^2.

Table 6 CO_2 Target Value (gCO_2/mi) for LDTs and MDPVs with Footprint < 41 ft^2

MY	Target Value
2017	238
2018	227
2019	220
2020	212
2021	195
2022	186
2023	176
2025	168
2025 and subsequent	159

For light-duty trucks and medium-duty passenger vehicles with a footprint that is greater than 41 ft^2 and less than or equal to the maximum footprint value specified in the table below for each MY, the following equation will determine the gCO_2/mi target value (value rounded to the nearest 0.1 gCO_2/mi):

$$\text{Target } gCO_2/\text{mile} = [a \times f] + b$$

Where f is the vehicle footprint and coefficients a and b are selected from Table 7 for the applicable MY.

Table 7 CO_2 Target Value (gCO_2/mi) for LDTs and MDPVs with Footprint > 41 ft^2 but ≤ 56 ft^2

MY	Maximum Footprint	a	b
2017	50.7	4.87	38.3
2018	60.2	4.76	31.6
2019	66.4	4.68	27.7
2020	68.3	4.57	24.6
2021	73.5	4.28	19.8
2022	74.0	4.09	17.8
2023	74.0	3.91	16.0
2025	74.0	3.74	14.2
2025 and subsequent	74.0	3.58	12.5

For light-duty trucks and medium-duty passenger vehicles with a footprint greater than the minimum footprint value but less than or equal to the maximum footprint value in Table 8 for the two MYs, the following equation will determines the gCO_2/mi target value (value rounded to the nearest 0.1 gCO_2/mi):

$$\text{Target } gCO_2/\text{mile} = [a \times f] + b$$

Where *f* is the vehicle footprint and coefficients *a* and *b* are selected from Table 8 for the applicable MY.

Table 8 CO_2 Target Value (gCO_2/mi) for LDTs and MDPVs

MY	Minimum Footprint	Maximum Footprint	a	b
2017	50.7	66.0	4.04	80.5
2018	60.2	66.0	4.04	75.0

For light-duty trucks and medium-duty passenger vehicles with a footprint that is greater than the minimum value specified in Table 9 the gCO_2/mi target value for the specific MY.

Table 9 CO_2 Target Value (gCO_2/mi) for LDTs and MDPVs

MY	Minimum Footprint	Target Value
2017	66.0	347
2018	66.0	342
2019	66.4	339
2020	68.3	337
2021	73.5	335
2022	74.0	321
2023	74.0	306
2025	74.0	291
2025 and subsequent	74.0	277

GHG Reducing Technologies

The proposed GHG standards are based on currently existing and emerging technologies in vehicles, including the increase in the efficiency of engines and transmissions, reduction in vehicle energy loads, improvements in auxiliary and accessory efficiency, and the increase use of hybrid and electric technology. Table 10 summarizes some of the technologies that are available to manufacturers to reduce GHG emissions.

Table 10 Summary of GHG Reducing Technologies

Area	Technology/Mechanism for CO2 Reduction	
Powertrain	Engine	Variable valve timing
		Cylinder deactivation
		Turbocharging
		Gasoline direct injection
		Compression ignition diesel
		Digital valve actuation
	Transmission	6+ speeds
		Continuously variable
		Dual-clutch, automated manual
Vehicle	Aerodynamics	
	Tire rolling resistance	
	More efficient steering, air conditioning, alternator	
	Lower refrigerant emissions	
	Mass Reduction	Advanced material component
		Integrated vehicle design
	Hybrid systems	Stop-start mild hybrid
		Full hybrid electric systems
	Electric drive	Plug in capable vehicles
		Fuel cell vehicles

CO_2 Standard Compliance

To determine the applicable sales-weighted CO_2 standard for its fleet of vehicles, each manufacturer must sort its vehicles into discrete model types and footprints for the applicable MY to determine the target CO_2 level. The individual target CO_2 level is multiplied by the number of vehicles of that model type/footprint for the specific MY. Each of these individual values are summed and then divided by the total vehicle production for the manufacturer:

$$CO_{2\ standard} = \Sigma[CO_{2target\ value} \times \text{model type production}]/\text{Total Vehicle Production}$$

The resulting CO_2 standard is determined by the manufacturer's sales-weighted CO_2 target levels for its mix of vehicles. The CO_2 standard will vary across manufacturers depending on the specific mix of their vehicle models.

Manufactures must demonstrate compliance with their sales-weighted CO_2 standard by calculating a combined "city" and "highway" grams per mile (g/mi) average CO_2 values for each model type and footprint group. GHG emissions used for the "city" CO_2 value calculation will be measured using the Federal Test Procedure (FTP) cycle (40 CFR, Part 86, Subpart B) and the Highway Fuel Economy Test

cycle (HWFET) for the "highway" test procedures (HWFET; 40 CFR 600 Subpart B). To calculate the fleet average emissions, the city values are multiplied with a weight factor of 55% and the highway values with a weight factor of 45%. Combined city/highway CO_2 values are then calculated using the following equation:

Combined city/highway CO_{2Value} = [0.55 x City CO_{2Value}] + [0.45 x Highway CO_{2Value}]

The combined city/highway CO_2 values for each unique combination of model type and footprint is multiplied by the total number of vehicles of that model type/footprint for the specific MY. The combined city/highway CO_2 values for each model type/footprint are summed and the result is divided by the total production of PCs or combined LDTs and MDPVs to calculate the manufacturer's actual sale-weighted average CO_2 value for the manufacturer's PC fleet or the combined LDT and MDPV fleet.

$$\text{Fleet}_{\text{AverageCO2 Value}} = \frac{[\sum [CO_{2\,\text{Combined city/highway}} \times \text{model type production}]}{\text{Total Number of PCs or combined LDT - MDPV Produced}}$$

CH_4 and N_2O Standard Compliance

Manufacturers have three options to comply with the CH_4 and N_2O standards. Manufacturers may elect one of the three options listed below:

Option 1 - California is proposing to adopt the federal U.S. EPA MY 2016 per-vehicle regulatory caps for its 2017-2025 regulations for CH_4 and N_2O emissions. Manufacturers will be required to test for these two pollutants starting with MY 2017 by vehicle type with full useful life certification limits of 0.030 g/mi CH_4 and 0.010 g/mi N_2O as measured on the FTP (40 CFR, Part 86, Subpart B).

Option 2 - manufacturers may elect to measure N_2O and CH_4 emissions for each combination of model type and footprint value on the FTP and the HWFET test cycles and multiply the measured N_2O and CH_4 emission data by 298 and 25, respectively, to determine the CO_2 equivalent emissions. These data are included in the fleet average calculations for PCs and combined LDTs and MDPVs, as calculated above and compared to the target values by MY and footprint values in Tables 1 through 6.

Option 3 - a manufacturer may select an alternative for either N_2O or CH_4, or both. Alternative N_2O and CH_4 standards apply to emissions as measured on the FTP test cycle (40 CFR, Part 86, Subpart B). Manufacturers electing to use an alternative standard for N_2O and/or CH_4 must calculate emission debits for each test group/alternative standard combination. Debits must be included in the calculation of total credits or debits generated in a MY using the equation below:

Debits = GWP × (Production) × (AltStd - Std)

Where:

Debits = N_2O or CH_4 CO_2-equivalent debits for a test group using an alternative N_2O or CH_4 standard;

GWP = 25 for CH_4 and 298 for N_2O;

Production = number of vehicles of that test group produced and delivered for sale in California;

AltStd = measured on the FTP test cycle; and
Std = exhaust emission standard for N_2O (0.01g/mi) or CH_4 (0.03 g/mi).

Additional Flexibilities

Many of the flexibilities allowed for MY 2016 vehicles will continue under the proposed MY 2017-2025 standards. For example, manufacturers will be allowed to take advantage of the provisions for averaging, banking (5-year credit carry-forward, 3-year credit carry-back), trading between car and truck categories, and trading between companies. In addition, manufacturers will be allowed to claim additional credits to bank or use to offset any debits generated toward meeting the CO_2 standards:

a) **Air Conditioning (A/C) Credit:** Allows manufacturers to generate credits by reducing GHG emissions related to A/C systems. A/C systems contribute to GHG emissions by placing an additional load on the engine which results in increased CO2 tailpipe emissions. In addition, leaking hydrofluorocarbon (HFC) refrigerants are also potent GHG pollutants. The A/C credit provisions offer an offset of up to 18.8 gCO2e/mile for cars and 24.4 gCO2e/mile for light-duty trucks if the manufacturer can demonstrate that their efficient A/C systems can provide CO_2 reductions commensurate to the amount of indirect credits allowed.[12]

b) **Alternative fuel vehicle Credit:** Allows manufacturers to generate credits from electric- and hydrogen-powered vehicles based on their incremental emission impact associated with California-specific low-GHG upstream energy sources. The proposed regulation would implement standards incorporating the relative GHG emissions associated with technologies for battery electric vehicles, plug-in hybrid electric vehicles, and fuel cell electric vehicles as compared to the conventional gasoline-powered vehicles. The intent of this provision is to provide a measure of certainty for manufacturers to include these advanced technologies in their fleets.

c) **Off-Cycle Credit:** Allows manufacturers to claim extra credit using the list of pre-approved technologies developed by U.S. EPA (such as active grill shutters that improve aerodynamics at high vehicle speeds, solar panels that significantly offset accessory electric loads and/or charge hybrid and electric-drive batteries, and solar control glazing that reduces the load from air conditioning). These optional credits can be used to offset tailpipe emissions by up to 10 grams CO_2 per mile.

d) **Full-Size Pickup Truck Technology Credit:** Allows manufacturers to generate extra credits from the deployment of emissions-reducing technologies on the largest of pickup trucks within the LDT regulations. Manufacturers can claim these credits for their vehicles as long as they meet certain eligibility criteria (i.e., minimum pickup bed dimensions, minimum payload requirements, minimum company pickup truck deployment, and technology-based criteria). The provisions are based on technology types (hybrid and non-hybrid performance-based) and two gCO_2/mile emission levels (10 and 20 gCO_2e/mile).

[12] To qualify for A/C credits, an automobile manufacturer would need to conduct either an engineering evaluation or conduct a new performance-based efficiency test, the AC17.

Compliance with GHG Standards (MY 2017-2025)
For each MY, manufacturers are required to demonstrate compliance based on one of two options:

Option A: The total number of PCs, LDTs, and MDPVs that are certified to the California exhaust emission standards and are produced and delivered for sale in Delaware; or
Option B: The total number of PCs, LDTs, and MDPVs that are certified to the California exhaust emission standards and are produced and delivered for sale in California, the District of Columbia, and all Section 177 states for that MY.

Manufacturers selecting Option B must notify DAQ, in writing, prior to the start of the MY or must comply with Option A. In addition, manufacturers must provide emission testing data and sales data for the combined fleet (California and Section 177 states) and separate data for the number of vehicles produced and delivered for sale in Delaware.

Credits/Debits
The values derived from the Fleet Average GHG are used to calculate GHG credits or debits that can be accrued by manufacturers for the MY and must be calculated separately for PCs and combined LDTs and MDPVs. A manufacturer that achieves fleet average GHG values lower than the fleet average GHG requirements for the corresponding MY will receive credits in units of g/mi GHG. These credits may be bought, sold, or traded among manufacturers. Conversely, a manufacturer with higher fleet average GHG values than the fleet average GHG requirement for the corresponding MY will accrue debits in units of g/mi GHG. When debits are incurred, they must be equalized within five years. The formula for calculating GHG credits/debits is:

$$CO_{2\,\text{Credit/Deb it}} = (CO_{2\,\text{Standard}} - CO_{2\,\text{Manufactur erFleetAve rageValue}}) \times (\#\,\text{Vehicle}_{\text{Produced and Delivered for Sale}})$$

A manufacturer's total Greenhouse Gas credits or debits generated in a MY shall be the sum of its CO_2 credits or debits, including any credits generated through A/C modifications, alternative fuel vehicle technology, off-cycle technology, and full-sized pickup truck technology. Manufacturers are required to submit emission testing and sales data to each of the Section 177 states for tracking and/or verifying purposes. For Delaware, this would allow DAQ to verify the manufacturers' average GHG levels for each MY. It should be noted that credits/debits earned through MY 2012-2016 National greenhouse gas program are not eligible for use under the proposed California's greenhouse gas program.

VI. AIR QUALITY IMPACTS

a. Overview

The proposed amendments are needed to guarantee that emissions reductions achieved will be maintained to meet federal ambient air quality standards. Implementation of the proposed LEV III and GHG standards for motor vehicles will result in a substantial reduction in criteria pollutants contributing to ozone formation and in CO_2 emissions in Delaware.

b. Low Emission Vehicle Exhaust Standards

Tables 16, 17, and 18 list the emission benefits for ROG, NO_x, and PM2.5 emissions expected from this proposal. Delaware's statewide emission benefits are calculated by using the proportionality of

California to Delaware's sale volume (which is 0.0368 or 3.68%). In other words, California's statewide emission benefits are multiplied by the ratio of the manufacturer's total sales volume in Delaware to the manufacturer's total sales volume in California to estimate the emissions benefits in Delaware. This approach was also used to estimate the reduction in CO_2 emissions from the GHG standards summarized below.

Table 16 Statewide Emission Benefits of the Advanced Clean Car Program: Reactive Organic Gas (ROG)

Statewide ROG (tons/day)			
Calendar Year	**Reductions from Existing LEV II Standards**	**Reductions from Proposed LEV III Standards**	**Benefits from LEV II to LEV III**
2023	7.0	6.7	0.3
2025	6.5	6.0	0.5
2035	5.2	3.4	1.8

Table 17 Statewide Emission Benefits of the Advanced Clean Car Program: Reactive Oxides of Nitrogen (NO_x)

Statewide NO_x (tons/day)			
Calendar Year	**Reductions from Existing LEV II Standards**	**Reductions from Proposed LEV III Standards**	**Benefits from LEV II to LEV III**
2023	7.4	6.8	0.6
2025	6.8	5.9	0.9
2035	5.0	3.2	1.8

Table 18 Statewide Emission Benefits of the Advanced Clean Car Program: Particulate Matter ($PM_{2.5}$)

Statewide $PM_{2.5}$ (tons/day)			
Calendar Year	**Reductions from Existing LEV II Standards**	**Reductions from Proposed LEV III Standards**	**Benefits from LEV II to LEV III**
2023	0.9	0.9	0.0
2025	1.0	0.9	0.1
2035	1.1	0.9	0.2

California used the EMFAC[13] 2011 model to estimate the environmental benefits of the Advanced Clean Cars Program. By 2035, ROG statewide emissions would be reduced by 34%, NO_x emissions by 37%, and $PM_{2.5}$ emissions by 9% compared to MY 2035 vehicles without the proposed standards. The emission benefits will be greater in the later years when vehicles are expected to be fully compliant with the proposed Advanced Clean Car standards.

[13] ARB's Emission Factors model (EMFAC2011) which is used to model statewide vehicle population and travel trends based on California Department of Motor Vehicles data.

c. Light-Duty Greenhouse Gas Standards

For MY 2017 to 2025 vehicles, the proposed GHG standards will result in CO_2 emission reductions of approximately 4.5% per year for the combined light duty fleet (PCs, LDTs, and MDPVs) (Table 19).

Table 19 CO_2 Emission Reductions

		PC		LDT-MDPV		Combined PC-LDT-MDPV	
	MY	gCO_2/mi	Annual Change (%)	gCO_2/mi	Annual Change (%)	gCO_2/mi	Annual Change (%)
Previous Rule Target	2016	226	4.5	292	4.5	251	4.4
Proposed Rule Targets	2017	213	5.5	290	0.7	243	3.2
	2018	203	4.9	280	3.5	233	4.2
	2019	192	5.2	273	2.8	224	4
	2020	183	4.9	264	3.0	215	3.9
	2021	173	5.5	245	7.5	201	6.3
	2022	165	4.4	233	4.9	192	4.6
	2023	158	4.5	221	4.9	183	4.8
	2024	151	4.5	210	5.0	174	4.8
	2025	144	4.6	200	4.9	166	4.8
Average Change 2016-2025			4.9		4.1		4.5

The proposed GHG emission standards would result in CO_2 emission reductions from MY 2016 to MY 2025 of approximately 36% for PCs and approximately 32% for the combined LDTs-MDPVs. The overall impact of the GHG regulation would reduce CO_2 emissions by approximately 34% for the projected mix of vehicles sold, resulting in a fleet wide average decrease from about 251gCO_2/mi for MY 2016 to about 166 gCO_2/mile (Table 20).

Table 20 Fleet Wide CO_2 Emission Reductions by Manufacturer

Company	GHG emissions (gCO_2e/mile)			Reduction in GHG Emissions (%)	
	2008 Baseline *	2016 Target	2025 Target	2008 to 2016	2016 to 2025
BMW	335	235	151	30	35
Chrysler-Fiat	363	260	171	28	34
Ford	385	264	178	31	33
General Motors	372	274	184	26	33
Honda	296	240	157	19	35
Hyundai-Kia	309	238	155	23	35
Jaguar-Land Rover	447	274	184	39	33
Mazda	310	235	152	24	35
Mercedes	368	252	165	31	34
Mitsubishi	313	228	146	27	36
Nissan	329	248	164	25	34
Spyker	354	230	148	35	36
Subaru	341	255	169	25	34
Suzuki	338	237	155	30	35
Toyota	304	248	163	19	34
Volvo	377	248	163	34	34
Volkswagen	328	226	146	31	35
All	**336**	**251**	**166**	**25**	**34**

* The 2008 baseline is used as a technology reference because it is the most comprehensive dataset for which all data (e.g., sales, footprint, and CO_2 emissions for every model) are well characterized.

The proposed GHG standards would result in a decrease of CO_2 equivalent emissions by approximately 2.5 Million Metric Tons (MMT) per year by MY 2025 for Delaware. By MY 2035 and 2050, the CO_2 emission reductions would reach approximately 5.8 MMT/Year and 7.6 MMT/Year, respectively. The proposed GHG standards would result in a cumulative reduction of 157 MMT CO_2 equivalent from 2017 through 2050.

VI. ECONOMIC IMPACTS

a. Overview

The proposed standards under the Advanced Clean Cars Program are expected to affect prices for new vehicles. However, many of the technologies available to manufacturers are also expected to reduce fuel costs for the consumers. Although much of the price increase for new vehicles will be passed on to consumers, the overall fuel cost savings from the use of vehicles that comply with the regulation will positively affect consumers, due to higher mileage and extended warranties that operate longer at extremely low emission levels.

b. Low Emission Vehicle Exhaust Standards

Costs affecting vehicle price are assigned to direct costs (cost of hardware) and indirect costs (research and development, warranty, marketing, etc.). California estimated the cost-effectiveness of the price increase on the assumption that all new vehicles would meet the SULEV emission standard by 2025. ARB estimated that the average cost effectiveness of light-duty vehicles meeting the LEV III program relative to the 2008 fleet is about $4 per pound of NMOG + NO_x reduced. Motor vehicle control measures range up to $5 per pound of emissions while stationary source controls range up to $10 per pound of emissions reduced. The average incremental retail costs for PC/LDT1 in 2025 would be $55 and $177 for LDT2. The average incremental price for MDVs in 2025 is $75 for gasoline and $54 for diesel fueled vehicles. Consumers will see significant reductions in vehicle fuel costs from more efficient vehicles and extended warranties. Table 21 breaks down the incremental retail prices for light-duty vehicles by engine size and initial certification level.

Table 21 Incremental Vehicle Price Increase for 2025 LEV III Compliance ($/vehicle)

Vehicle Category	Initial Baseline Certification Level	4-cyl Engine	6-cyl Engine	8-cyl Engine	Average Incremental Price[14]	Average Incremental Price[15]
PC/LDT1	LEV	87	142	248	130	55
	ULEV	50	83	161	68	
	SULEV	0	0	0	0	
LDT2	LEV	87	142	248	159	177
	ULEV	50	83	161	111	
	SULEV	0	0	0	0	

(2009 dollars)

The adoption of the LEV III regulation is not expected to have any negative impact on dealerships, vehicle operators, businesses, and agencies at the local, state, or federal levels.

c. Light-Duty Greenhouse Gas Standards

The proposed amendments provide manufacturers with significant lead-time and considerable compliance flexibility. Furthermore, the proposed GHG standards are predicated on many existing and emerging technologies that increase engine and transmission efficiency, reduce vehicle energy loads, improve auxiliary and accessory efficiency, and include increasingly electrified vehicle subsystems with hybrid and electric drive trains. Many of the technologies that will be incorporated into MY 2016-2025 vehicles will not only reduce GHG emissions but will also reduce the fuel costs of PCs, LDTs, and MDPVs.

The costs associated with the technologies that manufacturers will need to incorporate into the MY 2016 -2025 vehicles are expected to result in price increases for new vehicles which will likely be

[14] Sales weighted average for each initial certification level, ARB ISOR LEV III Amendments, December 7, 2011.
[15] Sales weighted average for vehicle category, ARB ISOR LEV III Amendments, December 7, 2011.

passed on to consumers (Table 22). By 2025, the GHG standards are estimated to cost approximately the same between the PC and the combined LDT-MDPV.

Table 22 Summary of Incremental Price Increase for Vehicles

Scenario	Category	2017	2018	2019	2020	2021	2022	2023	2024	2025
GHG Regulation	PC	170	330	520	720	900	1070	1190	1310	1320
	LDT-MDPV	170	340	510	720	910	1090	1200	1310	1360
	Average	170	340	510	720	910	1080	1190	1310	1340

(2009 dollars)

However, purchasers of new vehicles in 2017 and beyond would experience a significant reduction in their fuel costs as a result of these technologies, and consumers will see their investments paid back in less than three years. Table 23 shows the incremental costs for a MY 2025 vehicle as well as the net lifetime savings and the average payback period under the proposed GHG regulation.

Table 23 Summary of Costs versus Savings for Compliance with GHG Standards

Technology Plan	Incremental Price ($/Vehicle)	Average Payback Period (yr)	Net Lifetime Owner Savings ($)
GHG	1340	2.1	5900

(2009 dollars)

Although the proposed GHG standards may result in increased vehicle purchase costs to Delaware consumers, the fuel cost savings from the use of more efficient vehicles will offset these increased costs in less than three years. As a result, within a few years, consumers will benefit from additional disposable income to spend on goods and services. This increase could boost the economy slightly, potentially resulting in the creation of some additional employment in Delaware.

d. Aggregated Economic Impacts of Advanced Clean Cars Program

The combined impact of the proposed amendments contained in the Advanced Clean Cars Program is an expected reduction in fuel-consumption and costs for new vehicles ranging from approximately 4% to over 25% for MY 2017 to 2025 vehicles, respectively. The overall average increase in price of the vehicles compared to the overall reduction in fuel costs can be expressed as - for every dollar spent, consumers would save $3 (Table 26).

Table 26 Estimates of Cost Savings for Advanced Clean Cars Program

MY	Cumulative Annualized Incremental Costs ($)	Fuel Cost Savings ($)	Saving to Cost Ratio
2015	1	0	0:0
2016	4	0	0:0
2017	33	228	7:0
2018	100	487	4:9
2019	225	915	4:1
2020	392	1,438	3:7
2021	609	2,092	3:4
2022	868	2,918	3:4
2023	1,163	3,751	3:2
2024	1,495	4,671	3:1
2025	1,827	5,755	3:1
2026	2,153	6,846	3:2
2027	2,475	7,843	3:2
2028	2,796	8,803	3:1
2029	3,114	9,709	3:1
2030	3,430	10,630	3:1

(2009 dollars)

The expected cost-effectiveness of the proposed changes to the regulation is that, for every ton of greenhouse gas reduced, the savings will range from $290 in 2025 to $320 in 2035. Table 27 provides the cost effectiveness of the Advanced Clean Cars Program. Overall, purchasers of new vehicles in 2015 and beyond would experience a significant reduction in their fuel cost as a result of the proposed regulation.

Table 27 Estimated Cost Effectiveness of Advanced Clean Cars Program

Year	$PM_{2.5}$ ($/pound reduced)	$ROG+NO_x$ ($/pound reduced)	CO_2e ($/ton reduced)
2025	$0	$4	$290 savings
2035	$0	$3	$320 savings

(2009 dollars)

VII. REFERENCES

ARB: Advanced Clean Cars Summary -http://www.arb.ca.gov/msprog/clean_cars/acc%20summary-final.pdf.

ARB: Appendix A – Proposed Regulation Order. Amendments to Sections 1900, 1956.8, 1960.1, 1961, 1961.1, 1961.2, 1965, 1968.2, 1968.5, 1976, 2037, 2038, 2062, 2112, 2139, 2140, 2145, 2147, 2235, and 2317, Title 13, California Code of Regulations. August 7, 2012.

ARB: Enclosure A – Proposed 15-Day Modified Text of the "LEV III" Amendments to the California Greenhouse Gas and Criteria Pollutant Exhaust and Evaporative Emission Standards and Test Procedures and to the On-Board Diagnostic System Requirements for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles, and to the Evaporative Emission Requirements for Heavy-Duty Vehicles. February 22, 2012.

ARB Staff Report: Initial Statement of Reasons for Rulemaking, Amendments to New Passenger Motor Vehicle Greenhouse Gas Emission Standards for Model Years 2012-2016 to Permit Compliance Based on Federal Greenhouse Gas Emission Standards. January 7, 2010.

ARB Staff Report: Initial Statement of Reasons, LEV III Amendments to the California Greenhouse Gas and Criteria Pollutant Exhaust and Evaporative Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles. December 7, 2011.

DAQ: Background Document and Technical Support on LEV II. October 2010.

IPCC. (2007) Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf

U.S.EPA: Title I – Air Pollution Prevention and Control, Part D – Section 177, 42 U.S.C. §7507.

U.S.EPA: Title II – Emission Standards for Moving Sources, Part A – Section 209, 42 U.S.C. §7543.